

DOCUMENT RESUME

ED 111 152

95

EC 073 526

AUTHOR Hillman, Stephen B.
TITLE Teacher Questions: A Review of the Literature and Suggestions for Research with Respect to the Mentally Handicapped. Working Paper 17.1.
INSTITUTION Indiana Univ., Bloomington. Center for Innovation in Teaching the Handicapped.
SPONS AGENCY Bureau of Education for the Handicapped (DHEW/OE), Washington, D.C.
PUB DATE 27 Oct 71
GRANT OEG-9-242178-4149-032
NOTE 41p.
EDRS PRICE MF-\$0.76 HC-\$1.95 Plus Postage
DESCRIPTORS Exceptional Child Research; *Mentally Handicapped; Performance Factors; *Questioning Techniques; *Research Needs; Research Reviews (Publications); Teacher Evaluation

ABSTRACT

Reviewed is research dealing with teacher questions and their effects on mentally retarded children. Cited are studies involving classification systems for questions, patterns of teachers' questioning, training of questioning behaviors, and effects of questions on normal students. Among implications noted for mentally retarded persons are the needs for further research on the generalization effects of questions and in the area of validation. (CL)

* Documents acquired by ERIC include many informal unpublished *
* materials not available from other sources. ERIC makes every effort *
* to obtain the best copy available. nevertheless, items of marginal *
* reproducibility are often encountered and this affects the quality *
* of the microfiche and hardcopy reproductions ERIC makes available *
* via the ERIC Document Reproduction Service (EDRS). EDRS is not *
* responsible for the quality of the original document. Reproductions *
* supplied by EDRS are the best that can be made from the original. *

ED111152

TEACHER QUESTIONS: A REVIEW OF THE LITERATURE AND
SUGGESTIONS FOR RESEARCH WITH RESPECT
TO THE MENTALLY HANDICAPPED¹

Stephen B. Hillman

October 27, 1971

Working Paper 17.1

Center for Innovation in Teaching the Handicapped
Indiana University

U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY.

EC 073 526

¹This research was partially supported by grant #OEG 9-242178-4149-032 from the U. S. Office of Education, Bureau of Education for the Handicapped to the Center for Innovation in Teaching the Handicapped. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

TEACHER QUESTIONS: A REVIEW OF THE LITERATURE AND
SUGGESTIONS FOR RESEARCH WITH RESPECT
TO THE MENTALLY HANDICAPPED

Stephen B. Hillman

Center for Innovation in Teaching the Handicapped
Indiana University

Introduction

The present review of research represents an attempt to describe the current state of activity on the subject of teacher questions and to offer potential applications of the methodology and experimental results to research on the training of teachers of the mentally handicapped. Particular focus is given to (1) the importance of studying teacher questions, (2) methods of classifying teacher questions, (3) descriptive studies of teachers' questioning behaviors, (4) the training of teachers' questioning behaviors, (5) effects of questions on student behavior, (6) the relationship of teacher questions to the mentally handicapped, and (7) the need for validation studies on teacher questions and their effects. It should be made clear from the outset that placing the discussion of the mentally handicapped toward the end of the paper was necessitated by (1) the need to present a considerable amount of background data on teacher questions first, and (2) the scarce amount of research pertaining to the particular issue of teacher questions and the mentally handicapped, rather than by any perceived lesser importance of the topic itself. It is the belief of the author that this organization will allow the reader to gain a greater "feel" for the topic of teacher questions and their great importance in the teaching of the

mentally handicapped, as opposed to having a discussion of applications run throughout the report.

Importance of Studying Teacher Questions

That questions play an important role in teaching has long been recognized by educational researchers. Aschner (1961), for example, called the teacher "a professional question maker" and claimed that question asking is "one of the basic ways by which the teacher stimulates student thinking and learning." Other indices of the importance attributed to questions by the educational community are the amount of work being done in the training of teacher questioning skills (e.g., Rogers & Davis, 1970), the publication of a recent review of the use of questions in teaching by Meredith D. Gall in a 1970 Review of Educational Research, the widespread use of Sanders' book, Classroom Questions: What Kinds? (1966) in undergraduate teacher education classes, and the large number of articles being published on the subject in general.

It is easily documented that questions play a major role in a teacher's daily verbal activity. Over 50 years ago, Stevens (1912) estimated that 80% of the time spent in school was occupied by question-and-answer recitations. He further reported that a sample of high school teachers asked an average number of 395 questions per day. More recently, teachers have been found to employ high frequencies of questions in their classrooms: Floyd (1960) found an average number of 348 questions being asked by ten primary grade teachers in a typical school day; 12 elementary school teachers asked an average of 180 questions on a science lesson (Moyer, 1966); 14 fifth-grade teachers asked an average of 64 questions each in a 30-minute social studies lesson

(Schrieber, 1967); and figuring the rate of teacher questioning only during periods of substantive subject matter-related talk in nine junior high school English classes, Hoetker (1967) found that teachers asked questions at the rate of 5.17 per minute, or one question every 11.8 seconds, or at the rate of better than 300 questions per hour. The incidence of questions in teacher-student discussions, of course, does not represent the only exposure that students have to questions, as questions also are to be found in great frequency in textbooks and examinations.

The mental limitations of the retarded child, his apparently greater need for structured lessons as opposed to independent learning situations, and some recent documentation of the manner in which the child of lower ability is slighted in terms of classroom interactions with the teacher (Brophy & Good, 1970) all point to the urgent need for developing systematic classroom instruction techniques. Since questions can serve as initiators of teacher-student interactions, it seems to be of vital importance that teacher questioning skills be developed as at least one avenue in meeting the need for greater teacher ingenuity in the structuring of classroom learning activities and in interacting with the mentally handicapped. It is important as well that empirical data be gathered in order to determine which structuring and presentation techniques are best for producing the desired student behavior.

Classification of Questions

In order for researchers to describe the questioning behaviors of teachers in classrooms, it is necessary to have a system whereby these data can be gathered and made meaningful. Given that accurate and

reliable observation is the cornerstone of any empirical science, it was necessary for early researchers dealing with classroom data to develop systematic observation systems. Several systems have been proposed in recent years which would allow the investigator to categorize these questions into different groups. No fewer than 14 such classification systems have been proposed, ten of these in the last six years (Adams, 1964; Aschner, 1961; Bloom, 1956; Brown, Ober, & Soar, 1967; Carner, 1963; Clements, 1964; Gallagher, 1965; Guszak, 1967; Lynch & Ames, 1971; Moyer, 1966; Pate & Bremer, 1967; Reynolds, Abraham, & Nelson, 1971; Sanders, 1966; Schreiber, 1967).

Many of these question classification systems are based almost entirely on the type of cognitive process thought to be required to answer the question, and this creates several kinds of problems for the researcher. First, category names such as divergent thinking, convergent thinking, problem solving, comprehension, application, analysis, synthesis, evaluation, and memory, for example, may be found in one or more of the above systems. Often, these categories, while having the same name, will not in fact describe the same set of teacher behaviors so that, operationally speaking, the terms do not mean the same thing. As a result, it becomes difficult to draw general conclusions from several different studies, for they are not dealing with the same phenomena. The category label problem also leads to difficulties in researcher-observer agreement as to the behaviors which appropriately correspond to the categories. Often common understandings of particular words, such as comprehension or analysis, may cause interference in the learning of an observation system, while frequently-used words, such as

synthesis, may create difficulties in attempts to provide common understandings between the researcher and observer.

A slightly different, but related, problem involved in this cognitive process classification approach concerns itself with the inferential nature of having to group and categorize what are thought to be conceptually related teacher questions under the same label. Inasmuch as any particular category may be represented by numerous and often unpredicted varieties of teacher verbal statements, it is often a difficult inferential leap for an observer to code accurately the cognitive level of a teacher's question. Thus, attempts to gain a high degree of inter-rater reliability are pitted against a liability inherent in the nature of the system itself.

A second kind of problem related to these cognitive process systems is that of discerning whether in fact a particular question involves cognition (i.e., information processing) at all beyond a routine memory response. While a particular question may be identified as being at the comprehension level in Bloom's Taxonomy, for example, this is really only a prediction based upon the assumption that the pupil is not able to answer the question merely from memory alone. Let's take an example from concept learning. The concept to be taught is the mathematic concept of "even." The student is taught that if a whole number is divisible by "two," then it is "even." That is the rule. Now the examples given to the student are that 2 divided into 4 is 2 and that 2 divided into 6 is 3, so that 4 and 6 are now known by the student to be even numbers. If the teacher now asks if 12 is an even number and the student says "yes" because it is divisible by 2, then we might conclude that the student has the concept and also hypothesize

that something other than memory was involved in arriving at the answer. But, if the teacher asks instead if 6 is an even number, then it becomes obvious that the student may be able to respond correctly by simply using his memory and not have to use any cognitive processes at all. If someone had asked in the past if 12 was an even number, and he had remembered, then "Is 12 an even number?" would also be a memory question. And so it is with all cognitive-process categories. Without knowing the history of a student, it is impossible to be sure whether in fact he has answered the question from memory alone or whether he has used the cognitive process intended by the question.

A limitation of work done to date on the observation of classroom questions is that it has focused quite narrowly on only one set of important kinds of questions. This narrow focus, while valuable to the study of the specific phenomenon, i.e., cognitive questions, has served to ignore questions which may be intended for other purposes and thus has limited study of the more general problem of the different roles questions may play.

One example of a different type of classification system is that developed by Orme (1970). This system, in addition to having been taught to observers, also has been taught to both in-service and pre-service teachers as a set of questioning skills. This basic questioning technique, called Probing Skills, is one in which the teacher requires the students to go beyond their first-answer responses and is intended to upgrade the quality and quantity of student participation. Once a pupil has responded, by means of a question, answer, or comment, the teacher may probe that response by means of any one or more of the following

probing techniques: Clarification, Critical Awareness, Refocus, Prompting, Encouraging Alternatives, and Redirection. Skill in the use of probing techniques, it is claimed, "allows the teacher to control classroom interaction in such a way that he can 'shape' or build up the quality of pupil responses [Orme, 1970, p. 30]." Thus, particular kinds of questions may be used in controlling classroom behaviors which are only partly of a conceptual or cognitive nature and more of a social-motivational one. While probing techniques are intended, in part, to contribute to the cognitive climate of the classroom, it is clear that the social-motivational control aspect represents an important and apparently neglected aspect of questions and the purposes which they may serve.

Cognitive questions and probing techniques represent only two possible classes of questions. An entire, seemingly untapped, area of questions is those which are designed to produce an "affective" response (e.g., How do you feel about the war in Vietnam? Do you like baseball? What is your attitude toward bussing?) and may be used to create awareness, to facilitate attitude change, or to help in clarifying values. Questions such as these can play an important role in instruction and are deserving of greater attention by educational researchers.

Descriptive Studies of Teachers' Questioning Behaviors

While teachers generally agree that the development of students' skills in critical thinking represents a worthy educational objective, research to date has shown that this notion is seldom translated into the appropriate teacher classroom behavior.

Stevens (1912), in probably the first serious study of teacher questioning behavior, found that in a sample of high school classes varying in subject area and grade level, two-thirds of the teachers' questions required direct recall of textbook information. After a recent review of the literature, Gail (1970) summarizes the results of several studies and concludes that "about 60% of teachers' questions require students to recall facts; about 20% require students to think; and the remaining 20% are procedural [p. 713]," and further that "it is thus reasonable to conclude that in a half-century there has been no essential change in the types of questions which teachers emphasize in the classroom [p. 713]." Results of a very recent study (Lynch & Ames, 1971) show that this percentage of memory to thinking questions is still accurate, and further, that observations of normal and special education classes showed no significant differences with respect to number of questions asked per hour of instructional time or percentage of higher-level questions asked in each group, with the normal classes having 22.8% higher-level questions and the special education classes having 22.3%.

It is important to ask at this point why such a large percentage of questions are of the memory type. Several explanations can be offered. First, since memory or factual-recall questions probably represent the lowest level of cognition, they also represent the easiest questions for the students to respond to correctly. Thus, it is reinforcing for the teacher to hear so many correct answers. It also moves the lesson along quickly, keeps the students active and involved, and allows the teacher to get the information out in the open. A second reason may be that factual-recall questions are easy to make up. A third, since

few teachers have ever had any systematic training in questioning skills, it is not surprising that there is little systematic sequencing of questions or that the occurrence of higher cognitive questions is so neglected. A fourth possible explanation may be that, in the absence of any systematic training in questioning skills, it is probable that teachers will model the behavior of those who taught them in public school, college, and in their teacher education program, thus creating a self-perpetuating system of cognitively low-level question asking.

To answer the question as to why teachers ask a high percentage of memory questions, however, does not answer the question as to why they may think it important to do so. It seems reasonable that teachers may believe that memory questions are important because students have to know the facts first. This is a fairly common belief as well as the content of frequently-used curriculum manuals. While few people would argue that facts are not important, it should be clear that the attainment of facts is not the goal of education, but merely part of the means to more desirable ends. The fact remains, however, that with as much information as it is necessary to cover (as communicated by the curriculum guide, the textbook, standardized achievement tests given at the end of the year, etc.), precious little time remains for meeting other objectives anyway.

But still, teachers will say that critical thinking is important, that problem solving is important, that, in fact, we ought to be teaching students how to think. What is it then which accounts for the apparent discrepancy between what teachers say they value, i.e., critical

thinking skills, their actual teaching behavior, and their often inaccurate perception of their own behavior (a recent study by Steele, House, & Kerins [1971] shows that students are more accurate perceivers of teacher behavior than the teachers themselves). One reasonable hypothesis may be that the discrepancy between desired ends and achieved ends is only observable if the ends have been behaviorally specified. Without objectives which are stated in terms of student terminal behavior, i.e., what the student should be able to do after instruction is completed, it is impossible to determine if such a discrepancy exists. Generally speaking, most school objectives have been stated in exceptionally vague terms without any regard for the identification of the desired student behavior. When such a situation exists, it becomes impossible to determine what has been taught, if anything has been learned, and which methods of instruction may be best for producing particular kinds of behaviors.

The absence of behaviorally-stated objectives makes it impossible to study relationships between educational goals and instructional strategies, between teacher behavior and pupil behavior. Consequently, if one cannot demonstrate that particular teaching strategies are effective or ineffective in producing changes in student behavior, then any method becomes as good as any other method in terms of empirical criteria. While one probably could make a theoretical or logical case for the greater appropriateness of a certain strategy for particular objectives, the lack of any empirical evidence has allowed teachers to look upon their own behavior as acceptable or unacceptable in judging "good" teaching without apparent regard for the important criterion of how their behavior influences the achievement of their students. The use of behavioral

objectives, then, would force a teacher to focus on student behavior or results rather than on teacher behavior or methodology in judging his own effectiveness. The stating of behavioral objectives is an essential first step if teachers are to choose the appropriate criterion in judging their own effectiveness. In precisely identifying the desired student behavior, teachers will be able to separate more clearly the means from the ends, thus allowing a more systematic identification and examination of each and the relationship of one to the other.

Training of Teachers' Questioning Behaviors

Recently, several studies have demonstrated that teacher questioning skills can be taught and learned (e.g., Borg, Kelley, Langer, & Gall, 1970; Claus, 1969; Morse & Davis, 1970). Most of the studies use a microteaching format such that the student demonstrates the skill, receives feedback, and then demonstrates the particular skill again. In addition to the microteaching format and films, written materials (e.g., Gerhard, 1971; Minnis & Shrable, 1970; Sanders, 1966) also are available for use in more traditional teacher education programs. Whether or not questioning skills can be taught or learned is no longer a serious question. The main questions remaining in this area are (a) what are the conditions and treatments which will maximize the efficiency with which these skills may be learned, (b) what are the conditions and treatments which will maximize the development of teacher sequencing skills as these involve a different set of skills than those required for asking higher-level questions, and (c) what are the long-term effects of training in teacher questioning skills in terms of both teacher and pupil behavior.

Effect of Teachers' Questions on Student Behavior

While many studies have been done on teachers' questioning behaviors, it is unfortunately the case that the overwhelming majority have been descriptive. The hypothesis seems to be that if a student is exposed to certain types of higher-level cognitive questions, he will learn to "think" at a level which is consistent with the cognitive demand of that type of question and thus be able to answer similar types of questions better than a group of students who have not had this type of instruction. While this hypothesis is certainly a reasonable one, there is appallingly little evidence to suggest that teacher questions have any effect on student behavior.

Some important work has been done in this area by Hunkins (1967, 1968). The purpose of his research was to determine whether the variable of question type bears any relationship to student achievement. One group of his sixth-grade subjects worked exclusively with knowledge-level questions, while the other group worked with analysis-evaluation questions. Hunkins found that the analysis-evaluation group earned a significantly higher score on a specially constructed posttest than did students who answered questions that stressed knowledge. While Hunkins' findings are of interest and importance, they must be viewed as only suggestive because of serious methodological considerations, i.e., whereas the daily sets of questions asked the students to write out their answers, the criterion test was of a multiple choice nature. Furthermore, it appears to be a distortion of Bloom's Taxonomy to put evaluation questions into a multiple choice format, as evaluation is above synthesis in Bloom's Taxonomy and "synthesis thinking" is supposed to in-

volve the production of novel and creative responses.

Wright and Nuthall (1970) recently reported a study in which they explored the relationship between teacher behaviors and pupil achievement. Teacher behavior variables were identified from tape recordings and correlated with achievement test (developed on the basis of the lesson content outline especially for this study) scores which had been corrected for pupil intelligence and prior knowledge. The content and sequence of topics were held constant for all experimental teachers. Each teacher was to instruct the pupils on the life and habits of the "black-backed seagull" which is a bird native to New Zealand. Among other findings, Wright and Nuthall report that the mean class achievement scores correlated significantly with patterns and kinds of teacher questioning. Some teachers tend to ask one question at a time, while others frequently ask two or more in rapid succession in a single utterance. The data showed (a) that the tendency to ask one question at a time was related positively to achievement, (b) the tendency to ask several questions was correlated negatively with achievement, and (c) the greater the percentage of a teacher's questions which were closed (i.e., required single statements of fact, description, definition, naming) as opposed to open (i.e., required statements of opinion, evaluation, explanation, inference), the higher the achievement of the pupils. While these results are interesting and suggestive, one must be very careful in terms of the implications he draws about the effects of teacher questions on student behavior from correlational data.

A third study which has pupil learning as a dependent variable was done by Ladd and Anderson (1970) in which they investigated the

effects of the level of inquiry of teachers' questions on the achievement of 1000 ninth-grade earth science students in 40 classes. A median split was used in separating the 40 participating teachers into equal size groups of low- and high-inquiry teachers based upon observations of their teaching behavior. Results of this study, with adjustments made for intelligence, show that the students of high-inquiry teachers performed significantly better on tests which contained (a) low-inquiry questions only, (b) high-inquiry questions only, and (c) both high- and low-inquiry questions. The between-group differences were significant beyond the .001 level. The authors thus conclude that "teachers' questioning behavior strongly influences student achievement [p. 398]."

The fourth and final study to be reviewed in this group was done by Hilda Taba (1966). This enormous study, in terms of both its size and implications, sought to clarify the effects of teaching strategies on the cognitive functioning of elementary school children. While it is beyond the scope of this review to go into detail with regard to the fine points and methodology of the investigation, several findings and implications of these findings are of importance. First, in both experimental and control groups, teachers were fairly successful in getting students to give the response they sought; the untrained teachers, however, tended to be less successful even though they sought low-level responses more frequently than did the trained teachers. Second, even though the following result was not consistent among experimental classes, evidence from tests developed for this study showed that in ability to discriminate, to infer from data, and to apply known principles to new problems, the students of teachers who had been trained in the

skills of the three cognitive tasks were superior to those in classes with untrained teachers. And thirdly, results from an analysis of the tapescripts showed that the use of specific teaching strategies designed to foster development of cognitive skills seemed to make a difference in the general productivity of thought (i.e., not only a greater number of thought units, but also thought units of greater length and complexity, and tended to operate on higher levels of thought) as well as in the type of cognitive operations in which the students were engaged. "The most important observation that can be made from the data collected in this study," Taba states, "is the centrality and power of the teacher's role in initiating cognitive operations and determining which kinds are open to students [1966, p. 228]." The fact that students generally gave what teachers sought indicates the power that a questioning strategy has in determining which cognitive operations the students engage in.

The aforementioned studies were reviewed here because of their emphasis on pupil cognitive learning as a dependent variable and question type as an independent variable. Each of these five studies was conducted in a naturalistic setting, however, and thus, while the results might be generalized to similar environments, are subject to the natural limitations of such studies and threats to internal validity. Three of these studies are correlational (Hunkins, 1967, 1968; Wright & Nuthall, 1970) and thus cannot be used to support a causal relationship between the important variables. The nature of the Ladd and Anderson (1970) and Taba (1966) studies (i.e., large scale observation of teacher behavior) makes it impossible to pinpoint the precise relationship between the stimulus (i.e., teacher question) and the response (i.e.,

student cognitive achievement). There is, however, a number of small, carefully controlled, experimental laboratory-type studies which can shed some light on this relationship.

In recent years a large number of studies has been conducted with respect to cognitive learning from written materials. The term "mathemagenic" was coined by E. Z. Rothkopf and is defined as "those student activities that are relevant to the achievement of specified instructional objectives in specified situations or places [Rothkopf, 1970]." Rothkopf assumes that these student activities are modifiable, that if improperly controlled or uncontrolled may lead to irrelevant learning, and that the learner adapts his activities to the requirements of training questions or orienting tasks (1970). In attempting to gather empirical evidence in support of these assumptions, Rothkopf and others have focused mainly on the influence of training questions on learning from written materials. The following selected studies will give the reader a general review of the nature of this work, but are being reported here more importantly in order to provide a more complete review of the work being done on the effects of questions on student behavior.

A study by Rothkopf and Bisbicos (1967) hypothesized selective facilitative effects of interspersed questions on the learning of written materials. The 252 high school subjects were asked to read a 36-page, 9000-word passage about animals and minerals found in the sea. Two questions appeared in the text per each three-page zone, but the questions differed in location (before or after the relevant segment) and in required response. Different treatment conditions saw questions restricted to one of the following response types: (a) either a quantitative term

or name, (b) a common English or a technical word, (c) a mixture of (a) and (b). Each treatment group responded to the same 48-item criterion test after having read the passage. Results indicated that learning of the several categories of text content was facilitated by appropriate questions seen immediately after exposure to the relevant text segment as opposed to those seen before.

In a somewhat related study using a similar experimental design, Frase (1968b) was able to replicate the finding that retention was highest when questions were placed after the appropriate material. The 128 college students in this experiment were asked to read a 2000-word passage concerning the life of William James. Instead of questions being placed at two or three page intervals, however, questions were paced at the rate of one every ten, twenty, forty, or fifty sentences. The data indicated that retention increased with the frequency of posttreatment questions, but it decreased with frequent pretreatment questions. Question mode (multiple choice or constructed response) in terms of questions appearing in the text was also a variable, but had no effect.

The problem explored in the next study (Frase, 1968a) was to determine what happens to the retention of information contained in a passage when an orienting question is asked which requires the processing of relatively large or small amounts of the total information contained in that particular passage. Eighty-four college subjects were allowed 20 seconds to read a question and a 36-word paragraph. While the paragraph was the same for all subjects, the questions differed. One group of subjects read a specified question, another group a comparative question, and the third group a general question. Each question was read

by each experimental group before reading the paragraph. The results of the study showed that (a) the most precise question (i.e., specific > comparative > general) led to the most efficient acquisition of the specific stimulus-response association (i.e., more subjects in the specific question group passed the test item which was relevant to their question), and (b) when performance on the total retention test was the criterion, the groups scored in the same order (i.e., specific > comparative > general). While result (a) is consistent with the experimenter's hypothesis, result (b) is just the opposite of what was predicted. It was reasoned that general orienting questions would require the subjects to process greater amounts of information and thus their general retention would be higher. Though the results did not support this position, they did supply evidence for the selective information rejection (attention) position suggested by Berlyne (1965) and Schroder, Driver, and Streufert (1967) in which it is hypothesized that the greater uncertainty created by the comparative and general questions forced the subjects to engage in information rejection strategies in order to reduce the information load of the paragraph. Data derived in another project as part of this same study indeed add support to this position. To quote Frase, "the general conclusion seems to be that as effective uncertainty or information load increases, precise control over reading behavior becomes more imperative [p. 201]."

Another series of studies conducted by Frase (1969) and reported in monograph form induced subjects to think about text material by having them deduce conclusions from that material. The conceptual characteristics of the text material were analyzed in order to permit predictions

about which text items would enter memory as a function of different orienting directions. The ability to control learning from text material, it was stated, hinges upon an adequate understanding of this interactive process. It was clear from the results of the first experiment in this monograph that when a certain text item was a component of a problem solution, it had access to memory and was higher in recall than if it was not part of the problem solution. The basic hypothesis here is that, while subjects might scan an entire passage for the information necessary to draw a certain inference as communicated by an orienting direction or question, the text which is not relevant to that conclusion will receive only minimal processing and not have access to memory. This finding held for all three of the experiments in the monograph. Specifically though, experiment #1 showed that the recall of text items which mediated problem solution was greater than for those text points which did not mediate problem solution; experiments #2 and #3 demonstrated that inducing higher levels of information processing adds new items to memory and thus raises the overall level of recall, but does not increase the number of correct inferences.

A final study to be reported in this section concerns itself with the effects of written versus orally-communicated questions on learning from written materials (Rothkopf & Bloom, 1970). Sixty-three high school students studied a 16,000-word earth science text which was presented to them individually on 180 slides. In one experimental group, a written question related to the previous reading appeared after every sixth slide. The subject then wrote down his response on a

piece of paper, but received no feedback. The second experimental group received an oral question asked by a teacher after every sixth slide. The subject gave his response, but received no feedback. The control group received no questions. The results indicated that the oral question group scored significantly higher on a recall criterion test than did the written question group, and that both groups scored significantly higher than the control.

In summarizing briefly, it seems obvious that different questions can in fact produce different learning outcomes (e.g., Frase, 1968a & b; Rothkopf & Bisbicos, 1967). This is known. It is known also that inducing higher levels of information processing can raise the overall level of recall (Frase, 1970). However, a most important factor is not known and this is a function of the criterion task which has been chosen for each of these studies--either recall or recognition. Each serves as an index of memory. And therefore, what is needed is an investigation of the relationship between text material, orienting directions (e.g., questions and questioning sequences), and more cognitive information processing-type criterion tests. Once more is known about the relationship between these and other variables, it will be appropriate to add the important social dimension of the classroom (Rothkopf & Bloom, 1970) in order to gain a result which has greater generality to classrooms.

Relationship of Teacher Questions to the Mentally

Handicapped: Implications and Recommendations

Conclusions from a descriptive study done on instruction in special education classes (Lynch & Ames, 1971) suggest that low-ability children in regular classes are likely to miss out on opportunities for intellectual

stimulation from the teacher. Other studies suggest further that there is indeed a qualitative difference in teacher interaction with high-achieving and low-achieving students. Deutch (1966) has presented data which suggest that teachers call on students they expect to give the right answer more often than students they believe will give the wrong answer, and, in fact, will wait for a longer period of time for the right answer from students they "expect" to give the right answer. Indeed, the entire expectancy phenomenon suggests that slow learners, or more pointedly, those who are "expected" to learn more slowly, may receive both quantitatively and qualitatively different stimuli from the teacher during classroom interactions. The work of several other researchers, e.g., Brophy and Good (1970), also serves to support this conclusion. In the process of investigating the processes by which teachers communicate differential performance expectations to different children, Brophy and Good found that the teachers demanded better performance from those children for whom they had higher expectations and were more likely to praise such performance; that they were more likely to accept poor performance from students for whom they held low expectations and were less likely to praise good performance from these students when it occurred; that students for whom teachers had lower expectations were likely to receive greater amounts of criticism following incorrect responses to teacher questions; and that the high-expectation students were the ones for whom teachers repeated or rephrased a question after a wrong answer was given as opposed to the ones for whom they had low expectations. It was also found that the highs initiated more work-related contacts and created more response opportunities for themselves than did the lows.

It appears from these and other studies that questions serve a vital function in creating opportunities for teacher-student interaction. And if the intent of any question is to produce a response on the part of the student, once that response is given the teacher must in turn respond to the student's answer. This creates an excellent opportunity for the child to be reinforced for his answer if he succeeds in producing the correct response. Part of the explanation for why a person answers a question correctly or incorrectly may lie with the person himself (e.g., knowledge, motivation, etc.). The other part is a function of the type and level of the question itself. A teacher may greatly enhance the likelihood of a student's getting an answer right if he has skill in asking questions which are, in fact, at a level at which the student may be able to respond, or if he has skill in rephrasing or in asking simpler questions of a student who does not respond correctly. A questioning sequence ought to begin with successful student responses, much like a programmed text. As in the program, few people could respond to the last frame successfully without going through the program, while most could respond to the first with ease. It is the frame sequence which ultimately leads to success on the last frame. It is the same with classroom questions. The importance of this cannot be stressed enough. Given the Brophy and Good (1970) data just reviewed, it seems imperative that techniques be developed as well as training materials in an attempt to modify the question-asking skills of teachers in general, but particularly for teachers of the mentally handicapped child. Behavior modification techniques have been demonstrated to be successful with mentally handicapped children (Prehn & Crosson, 1969), not to mention in normal

classrooms (e.g., Krasner & Ullman, 1966; Ullman & Krasner, 1966). The skills required in creating the opportunity which will increase the likelihood of a correct response, however, are complex indeed, but mastery is essential if success experiences are to be created in classrooms where they are obviously few in number.

It is necessary, as well, that research be done in an attempt to describe the best sequence of questions to be used in promoting particular kinds of cognitive-process goals. For example, should teachers ask more difficult questions first or factual-recall questions first? What is the effect of asking questions in an inference-explanation sequence where student responses to questions asking for inferences are followed up with questions asking for justification or explanations? What kinds of questioning sequences should be used when the student is unable to respond to the first question which is directed to him? What might the effects be if it is rephrased; if he is skipped and the teacher goes on to someone else; if the difficulty of the question is decreased, etc. Answers to these and other such questions are essential if one is to understand the consequences of teacher questioning behaviors.

Earlier in this report it was indicated that no research studies had focused on the transfer of training as a criterion variable in research on questions. It also appears that despite the seeming importance of knowledge about the conditions under which retardates transfer learning, the topic of transfer remains one of the most underresearched in the area of mental retardation (Prehm & Crosson, 1969). Transfer of training studies with question types, sequences, etc., as treatment variables thus must be recognized as an untapped, but obviously

important area for research.

Again, as indicated earlier in this report, it was stated that many of the category systems used in observing classrooms were based upon Bloom's Taxonomy; but only recently have researchers begun to investigate the taxonomy in order to test the hypothesis that it is in fact linearly hierarchical. While there is already some evidence which supports this notion (Kropp, Stoker, & Bashow, 1966; Smith, 1968; Stoker & Kropp, 1969), other evidence exists which casts doubt upon the hypothesis (Madaus, Nuttall, & Woods, 1971). It thus remains unclear whether the arrangement of categories is hierarchical and in the order described, i.e., according to complexity of process.

There is a little evidence to support the assumption that the hierarchy of categories is cumulative (Hughes & Nelson, 1970), i.e., that any category consists of the processes stipulated by all lower-level categories plus a process which is unique to it from the standpoint of lower-order categories. But there is nothing to suggest that the learning of this "process which is unique to it" is any more difficult at any level of the taxonomy. According to Prehm and Crosson (1969), it was assumed until recently that retardates were unable to manifest creative thought which is placed at the synthesis level of Bloom's Taxonomy. However, research has shown this assumption to be erroneous. Cawley and Chase (1967) report that special class retardates, regular class retardates, and nonretarded subjects matched on MA exhibited comparable performance on a battery of productive thinking tests. Smith (1967) found that when regular class retardates were matched with nonretarded subjects, and CA, IQ, level of academic achievement, and MA were

controlled through the use of analysis of covariance, the only difference in their scores on 22 Guilford-type tests of creative thought was in word fluency. Given these results, it seems imperative that researchers begin to study the assumptions made about the limited ability of retardates to function at other upper levels of the taxonomy. Not to test the limits of the assumptions is to do an injustice to those less capable.

Another area of concern is that of individualized instruction and the study of aptitude-treatment interactions. Recent studies suggest that, while teachers may show great variations in terms of their teacher-pupil interaction, these tend to be mainly unsystematic and of a quantitative nature as opposed to qualitative. Lynch and Ames (1971), for example, indicate that the teachers in their sample showed marked variations in (a) the frequency with which they interacted with individual students per unit of time, and (b) the extent to which they vary the cognitive levels of their instructional communication with individual pupils. They conclude, however, that there is no evidence "that the different opportunities provided different children described here represent deliberate adjustments to individual levels of readiness and need [p. 25]." The conclusions of another recent study on individualized instruction (Neujahr, 1971) suggest again that while the frequency of interaction may vary greatly across pupils, there is considerable evidence in support of consistency of the teacher's role as he interacts with different pupils in an individualized format; the primary function of the teacher remains soliciting of information, i.e., questioning.

It seems, then, that teachers do not make systematic adjustments in their behavior while engaging in classroom interactions. Student-teacher interactions seem to proceed in a fixed order, lock-step fashion in spite of any feedback the teacher might obtain during the interaction. It seems critical, then, that studies be done to (a) outline meaningful categories of student responses to teacher questions, (b) determine more precisely what a teacher would do if she thought diagnostically, i.e., to make the maximum use of this feedback, (c) develop methods in training teachers to behave in this manner, and (d) to develop methods by which teachers may be trained in the use of aptitude-treatment interactions in order to derive the greatest benefits from individualized instruction. The varying and appropriate sequencing of the cognitive level in teacher-pupil interactions is dependent upon answers to these and other questions.

A Word About Validation

The following section will deal with two separate, but related, types of validation studies which need to be done with respect to cognitive demand type questions. The first is a kind of psychometric validation of observation instruments, while the second is a curricular validation in terms of influences of questions on student behavior.

According to psychometric theory, validation is only necessary when measurement is indirect, when one attempts to measure inferences and abstractions. Questions of validity are not important when one makes direct observation of behavior. And while it might be desirable to measure behavior directly and not make inferences, it is not possible when dealing with cognition in the complex environment of the classroom.

All of the observation systems identified in this paper are based on the a priori delineation of particular types and examples of teacher statements thought to represent various kinds of thinking. One then classifies when observing classrooms teacher and/or student statements into the appropriate category of thought. While this leads to problems, it is necessary for naturalistic studies. Any category supposedly represents an almost infinite variety of possible stimuli or questions which may be used to cue a particular thought process. These classroom questions are presented in behavioral form whether written or oral (e.g., List the names of three U. S. Presidents; Name the steps in the scientific method; Point to an instance of the concept "prime number"), not as abstractions (e.g., Understand the scientific method; Show me that you comprehend the concept of "prime number"; etc.). But because there are so many possible ways of communicating a question at any particular level, if one merely recorded behaviors the result would likely be a typescript--a form of data not very conducive to systematic analysis.

Any given question contains two kinds of stimuli: the stimulus which cues a person to the appropriate content area and the stimulus which cues a person to the required cognitive process. It is necessary that an empirical analysis of the process stimulus be done in order to determine the manner in which this is communicated to the student and the effect which it has upon him. Questions may then be grouped in terms of their similar effects upon student behavior and given any labels one may wish. Until such time as researchers can be more certain of the similar nature of the cognitive demands of questions grouped

under a common label, they will be limited with respect to the confidence they can give to such classroom descriptors. An observation system may be used reliably, but unless its categories can be demonstrated to have validity, its usefulness is severely reduced.

The second type of validation to be discussed here is that of curricular validation. Once it has been established that particular kinds of questions are similar in terms of their cognitive demands, but that different types of questions can produce different kinds of cognitive effects in terms of student behavior, it then will be appropriate to study "questions" as part of the teaching act. Hypotheses concerning when particular types of questions should be used, what questioning sequences may be best for particular objectives, the relationship of cognitive skills to different subject areas, and the collection of any and all student and teacher behavioral correlates to the teacher's manipulation of cognitive demands then are capable of being examined. Hypotheses concerning hierarchies, the cumulative nature of these hierarchies, and multi-level approaches to cognition also can be researched as well as the concurrent and predictive validity of curricula (Rowher, 1971).

In order to study these types of validation, but of more importance for the second type, two conditions are necessary. First, precise control over the process stimulus and content stimulus portions of the question must be gained by teachers so that clear control of the questions and question sequences can be obtained and manipulated as an independent variable. This will allow researchers to control teacher behavior and thus provide the necessary data for supporting causal relationships.

The second necessary condition involves the nature of the measurement of the student behavior. The criterion typically used in past studies which examines the influence of teacher questions on student behavior has been of a factual-recall nature. While it has been shown that the particular kind and placement of a question can influence recall or recognition of bits of information, it remains to be demonstrated that there are any effects in terms of other varieties of cognitive behavior. Other more appropriate criteria include the following: (a) horizontal transfer of training (Klausmeier & Davis, 1969) where the learning of one task facilitates performance on another task of about the same level of complexity (e.g., if inference-type questions are supposed to allow students to develop skills in making inferences, then given new data, students who have been exposed to this treatment condition ought to do better at making accurate inferences than students who have not), (b) vertical transfer of training (Klausmeier & Davis, 1969) where knowledge or abilities acquired in performing one task facilitate the learning of higher-order tasks of the same broad class (e.g., if evaluation is a more complex task than inference-making, then learning how to make inferences may influence the learning of evaluation skills and show up as less time required for instruction on evaluation or fewer errors on a criterion test), and (c) learning how to learn (e.g., one of the things learned in teaching a concept is the concept itself, but how to learn a concept is something which also may be learned in instructional situations which teach concepts. Given new data with different attributes, a student who has been exposed to teaching where a teacher asked questions aimed at pro-

ducing concept learning ought to be able to derive concepts from the data independently to a greater degree than a student who has not). Without answers to these and other validation issues, educators will never know the effects of their questions and thus will not be able to select the most appropriate question or question sequences in attempts to attain particular objectives.

Summary and Conclusions

This paper has attempted to review the literature on the use of teacher questioning behaviors in general and in particular to identify a number of important areas for investigation with respect to teacher questioning and the mentally handicapped. There are many, many studies to be done in the area which overlap these two variables of which only a few have been described. However, those which are mentioned are deemed critical to the continuing development of skills in teaching the mentally handicapped.

While it is difficult to single out any one problem as being the most pressing, the point is made that the question of validation seems to be of greatest importance at the present time. Given the great absence of research on a question of "do students 'think' differently as a function of the supposed cognitive level of the question asked them?", it would seem that this represents the area where there is the greatest need for empirical work to be done. If students do learn to "think" differently as a function of question level, then one would expect this to be displayed in such criterion tasks as transfer of learning (both horizontal and vertical) as well as learning-to-learn situations. If this

can be demonstrated, then all of the other problems such as sequencing, training in diagnostic and question-asking skills, training in individualized instruction, etc., become much more meaningful. Without such evidence, these questions cease to be important at all.

References

- Adams, T. H. The development of a method for analysis of questions asked by teachers in classroom discussion. (Doctoral dissertation, Rutgers University) Ann Arbor, Michigan: University Microfilms, 1964, No. 64-2809.
- Aschner, M. J. Asking questions to trigger thinking. N. E. A. Journal, 1961, 50, 44-46.
- Berlyne, D. E. Structure and direction in thinking. New York: Wiley, 1965.
- Bloom, B. S. (Ed.), Taxonomy of educational objectives: Handbook I: Cognitive domain. New York: David McKay, 1956.
- Borg, W. R., Kelley, M. L., Langer, P., & Gall, M. The minicourse: A microteaching approach to teacher education. Beverly Hills, California: Macmillan Educational Services, 1970.
- Brophy, J. E., & Good, T. L. Teachers' communication of differential expectations for children's classroom performance: Some behavioral data. Journal of Educational Psychology, October, 1970, 61(5), 365-374.
- Brown, B., Ober, R. L., & Soar, R. The Florida taxonomy of cognitive behavior. Gainesville: The University of Florida, 1967.
- Carner, R. L. Levels of questioning. Education, 1963, 83, 546-550.
- Cawley, J. F., & Chase, D. V. Productive thinking in retarded and non-retarded children. British Journal of Educational Psychology, November, 1967, 37, 356-360.

Claus, K. E. Effects of modeling and feedback treatments on the development of teachers' questioning skills. Technical Report No. 6, Stanford Center for Research and Development in Teaching, June, 1969.

Clements, R. D. Art student-teacher questioning. Studies in Art Education, 1964, 6, 14-19.

Deutch, M. Unpublished paper delivered at Colloquium at Indiana University, 1966.

Floyd, W. D. An analysis of the oral questioning activity in selected Colorado primary classrooms. (Doctoral dissertation, Colorado State College) Ann Arbor, Michigan: University Microfilms, 1960, No. 60-6253.

Frase, L. T. Some unpredicted effects of different questions upon learning from connected discourse. Journal of Educational Psychology, 1968, 59(3), 197-201. (a)

Frase, L. T. Effect of question location, pacing, and mode upon retention of prose material. Journal of Educational Psychology, 1968, 59(4), 244-249. (b)

Frase, L. T. Structural analysis of the knowledge that results from thinking about text. Journal of Educational Psychology Monograph, December, 1969, 60(6,2), 1-16.

Gall, M. D. The use of questions in teaching. Review of Educational Research, December, 1970, 40(5), 707-721.

Gallagher, J. J. Expressive thought by gifted children in the classroom. Elementary English, 1965, 42, 559-568.

- Gerhard, M. Effective teaching strategies with the behavioral outcomes approach. West Nyack, N. Y.: Parker Publishing Company, Inc., 1971.
- Guszk, F. J. Teacher questioning and reading. The Reading Teacher, 1967, 21, 227-234.
- Hoetker, J. Teacher questioning behavior in nine junior high school English classes. Research in the Teaching of English, 1967, 1, 99-106.
- Hughes, R. P., & Nelson, H. Y. Measuring relationships among and between cognitive and affective behaviors in a controlled learning situation. Paper presented at the Annual Meeting of the American Educational Research Association and the National Council on Measurement in Education, Minneapolis, March, 1970.
- Hunkins, F. P. The influence of analysis and evaluation questions on achievement in sixth-grade social studies. Paper presented at the Annual Meeting of the American Educational Research Association, 1967.
- Hunkins, F. P. The effects of analysis and evaluation questions on various levels of achievement. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, 1968.
- Klausmeier, H. J., & Davis, J. K. Transfer of learning. In R. L. Ebel, V. H. Noll, & R. M. Bauer (Eds.), Encyclopedia of educational research: A project of the American Educational Research Association. (4th ed.), London: Macmillan Co., 1969, 1483-1493.
- Krasner, L., & Ullman, L. (Eds.), Research in behavior modification. New York: Holt, Rinehart and Winston, 1966.

- Kropp, R., Stoker, H., & Bashaw, W. The construction and validation of tests of cognitive processes as described in the "Taxonomy of educational objectives." Cooperative Research Project No. 2117. Institute of Human Learning and Department of Educational Research and Testing, Florida State University, 1966.
- Ladd, G. T., & Anderson, H. O. Determining the level of inquiry in teachers' questions. Journal of Research in Science Teaching, 1970, 7(4), 395-400.
- Lynch, W. W., & Ames, C. A. Differences among special class teachers in individualization of instruction. Paper delivered at the Convention of the American Educational Research Association, New York, N. Y., 1971. (a)
- Lynch, W. W., & Ames, C. A. Personal communication. September, 1971. (b)
- Madaus, G. F., Nuttall, R. L., & Woods, E. M. A causal model analysis suggests modification of the cumulative hierarchical structure assumed in Bloom's taxonomy of the cognitive domain. A paper presented at the Annual Meeting of the American Educational Research Association, New York, N. Y., February, 1971.
- Minnus, D. L., & Shrable, K. Teachers manual: Improving questioning strategies. San Anselmo, California: Search Models Unlimited, 1970.
- Morse, K. R., & Davis, O. L., Jr. The effectiveness of teaching laboratory instruction on the questioning behaviors of beginning teacher candidates. Report Series No. 43, The Research and Development Center for Teacher Education, The University of Texas at Austin, February, 1970.

- Moyer, J. R. An exploratory study of questioning in the instructional processes in selected elementary schools. (Doctoral dissertation, Columbia University) Ann Arbor, Michigan: University Microfilms, 1966, No. 66-2661.
- Neujahr, J. L. An analysis of teacher communications to individual pupils when instruction is individualized. Paper presented at the American Educational Research Association Convention in New York, N. U., February, 1971.
- Orme, M. E. J. Effects of modifying teacher interaction skills on student behavior. Institute for Child Study, Indiana University, E. S. E. A. Title I Project #70-250 with Brown County School Corporation, Nashville, Indiana, 1970.
- Page, R. T., & Bremer, N. H. Guiding learning through skillful questioning. Elementary School Journal, 1967, 67, 417-422.
- Prehm, H. J., & Crosson, J. E. The mentally retarded. Chapter 1 in Review of Educational Research, February, 1969, 39(1), 5-24.
- Reynolds, W. W., Abraham, E. C., & Nelson, M. A. The classroom observational record. A paper delivered before the Annual Convention of the American Educational Research Association, New York, N. Y., February, 1971.
- Rogers, V. M., & Davis, O. L., Jr. Varying the cognitive levels of classroom questions: An analysis of student-teachers' questions and pupil achievement in elementary social studies. A paper delivered at the Convention of the American Educational Research Association, Minnesota, March, 1970.

- Rothkopf, E. Z. The concept of mathemagenic activities. Review of Educational Research, 1970, 40(3), 325-336.
- Rothkopf, E. Z., & Bisbicos, E. E. Selective facilitative effects of interspersed questions on learning from written materials. Journal of Educational Psychology, 1967, 58(1), 56-61.
- Rothkopf, E. Z., & Bloom, R. D. Effects of interpersonal interaction on the instructional value of adjunct questions in learning from written material. Journal of Educational Psychology, 1970, 61(6), 417-422.
- Rowher, W. D. Prime time for education: Early childhood or adolescence? Harvard Educational Review, August, 1971, 41(3), 316-341.
- Sanders, N. M. Classroom questions: What kinds? New York: Harper & Row, 1966.
- Schrieber, J. E. Teachers' question-asking techniques in social studies. (Doctoral dissertation, University of Iowa) Ann Arbor, Michigan: University Microfilms, 1967, No. 67-9099.
- Schroder, H. M., Driver, M. J., & Streufert, S. Human information processing. New York: Holt, Rinehart and Winston, 1967.
- Smith, R. An empirical examination of the assumptions underlying the "Taxonomy of educational objectives: Cognitive domain." Journal of Educational Measurement, 1968, 5, 125-128.
- Smith, R. M. Creative thinking abilities of educable mentally handicapped children in the regular grades. American Journal of Mental Deficiency, January, 1967, 71, 571-575.
- Steele, J. M., House, E. R., & Kevins, T. An instrument for assessing instructional climate through low-inference student judgments. American Educational Research Journal, May, 1971, 8(3), 447-466.

- Stevens, R. The question as a measure of efficiency in instruction: A critical study of classroom practice. Teachers College Contributions to Education, 1912, No. 48.
- Stroker, H., & Kropp, R. An empirical examination of the assumptions underlying the structure of cognitive processes using Guttman-Lingoes smallest space analysis. Paper presented at the Annual Meeting of the National Council on Measurement in Education, Los Angeles, 1969.
- Taba, H. Teaching strategies and cognitive functioning in elementary school children. Cooperative Research Project No. 2404, San Francisco State College, February, 1966.
- Ullman, L., & Krasner, L. (Eds.), Case studies in behavior modification. New York: Holt, Rinehart and Winston, 1966.